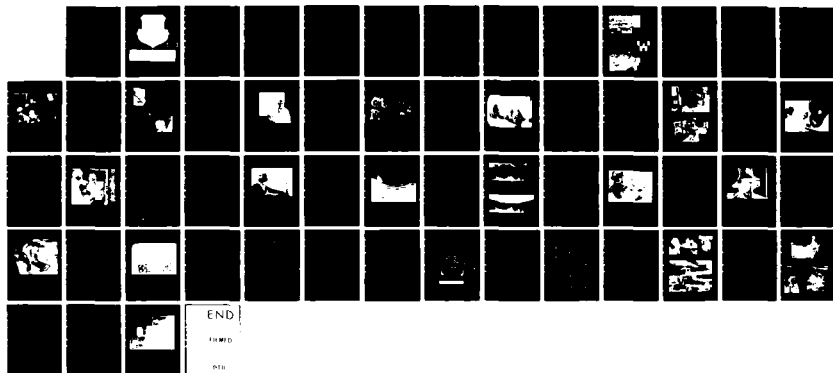


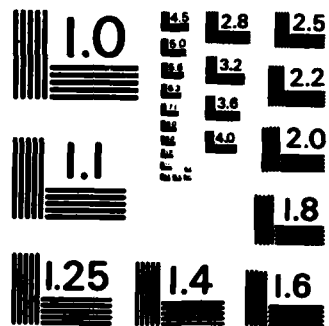
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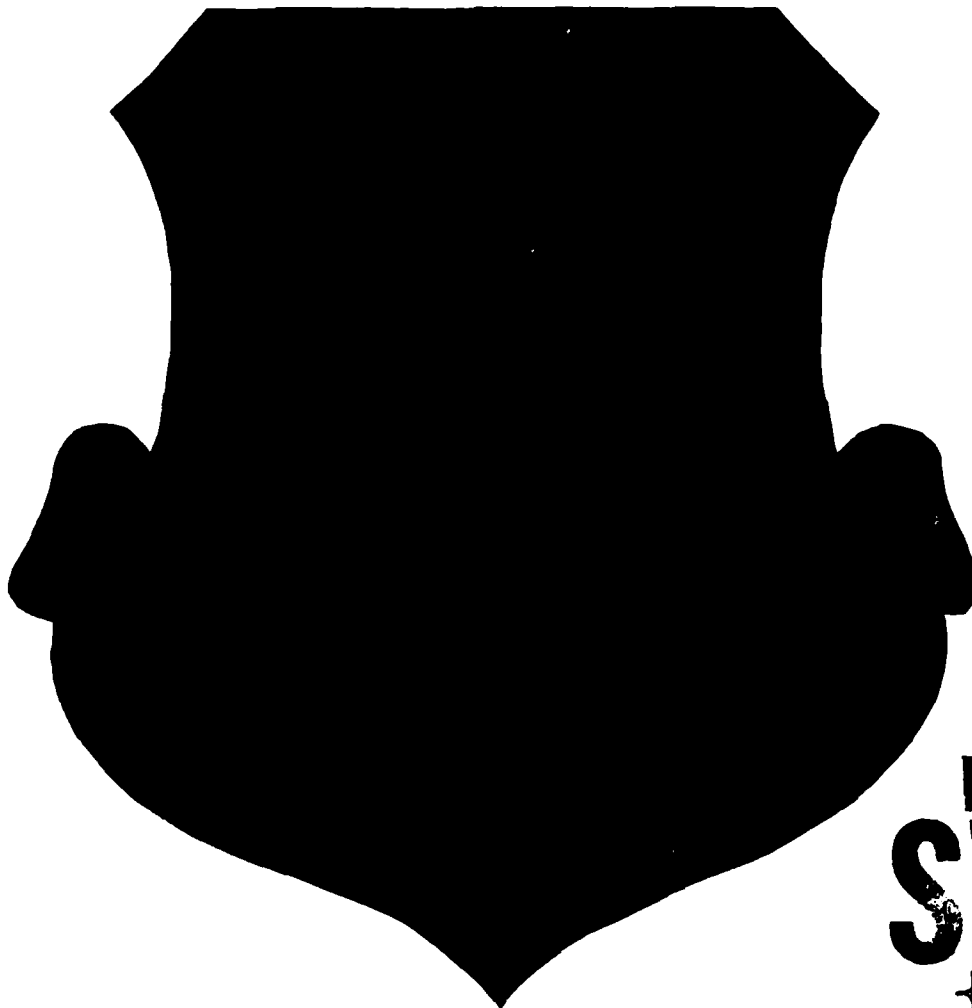
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AIR FORCE SYSTEMS COMMAND  
AIR FORCE HUMAN RESOURCES LABORATORY  
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The Public Affairs Office has reviewed this paper, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nations.

This paper has been reviewed and is approved for publication.

HERBERT J. Clark, Director  
Plans and Programs Office

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**1983 ACCOMPLISHMENTS**

**PLANS AND PROGRAMS OFFICE  
Brooks Air Force Base, Texas 78235**

**Reviewed and submitted for publication by**

**Herbert J. Clark  
Director  
Plans and Programs Office**

**This publication is primarily a working paper. It is published solely to document work performed.**

## Summary

The Air Force Human Resources Laboratory (AFHRL) is the principal Air Force Systems Command organization for planning and coordinating research, exploratory and advanced development in personnel management, weapons systems logistics, training for flight operations, and technical training. The mission of this laboratory is broader than that of most other laboratories because of the responsibility to develop information for making management and policy decisions on personnel. Human resources technology is particularly important because the largest single item in the DoD budget is the cost of personnel and the associated cost of training and supporting the force.

This report is designed to meet two objectives:

1. To let the research and operational communities become familiar with the useful products that have been developed at AFHRL.
2. To generate ideas to individuals who are working in these areas.

R&D accomplishments are presented in five major areas; none of which is mutually exclusive. All of these areas share interests with each other and with similar Air Force and DoD agencies.

Manpower and Personnel provides enhancements for the selection, classification, assignment, evaluation and retention of Air Force members.

Training Systems attempts to enhance training efficiency through analysis of job performance, delivery and sequencing of instruction.

Operations Training provides simulation and other training devices to improve the combat effectiveness of aircrews.

Logistics and Human Factors seeks improvements in the supportability of Air Force systems and the productivity of maintenance personnel.

This report of accomplishments is the first AFHRL publication of this type. It reflects work that has been completed in the foregoing R&D areas during 1983. Effective use of people in the man-machine environment of today's Air Force has not been achieved to everyone's satisfaction, but through efforts such as the ones mentioned in this paper, significant progress has been made.

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## 1983 ACCOMPLISHMENTS

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**MANPOWER AND PERSONNEL**

**TITLE:** Armed Services Vocational Aptitude Battery (ASVAB) Speeded Subtest Study

**PRODUCT:** Procedures That Switch to a 1980 Comparison Group for ASVAB Test Scores

**DESCRIPTION:** The ASVAB is the primary selection and classification device for enlisted entry into all the armed services. The Assistant Secretary of Defense (Manpower, Installations, and Logistics) designated the Air Force as Executive Agent for ASVAB Research and Development (R&D), and AFHRL as the lead Department of Defense (DoD) laboratory. Thus, an ongoing requirement exists for AFHRL to develop new versions of the test, to validate and standardize it, and to perform R&D for ASVAB program improvement.

Currently, ASVAB test scores are compared to the test scores of individuals who were in the military in December 1944. The scores of all applicants are converted to this 1944 score scale for purposes of enlistment and for historical comparisons. In 1980, the National Opinion Research Center (NORC) conducted a study to establish a contemporary reference population for the ASVAB. This new reference population was adopted by DoD, with plans to implement it in October 1983. However, when data from the NORC study were compared with data from military recruits and applicants, discrepancies between scores on the two speeded subtests of the ASVAB were revealed.

AFHRL began an investigation of the speeded subtests and concluded that discrepancies were due to differences between regular answer sheets and the answer sheets used in the NORC study. Scores were significantly lower when the NORC answer sheet was used because it took a longer time to fill in the answers than on the regular ASVAB answer sheet. A study involving over 9,000 service applicants at 19 Military Entrance Processing Stations was subsequently conducted by AFHRL to develop adjustments to data obtained from the 1980 reference population. The study resulted in a correction for the use of non-standard answer sheets in the NORC study and will, therefore, make it possible to switch to the 1980 comparison group. Implementation is scheduled for 1 October 1984. This will allow ASVAB scores to reflect aptitude in terms of the current pool of applicants.



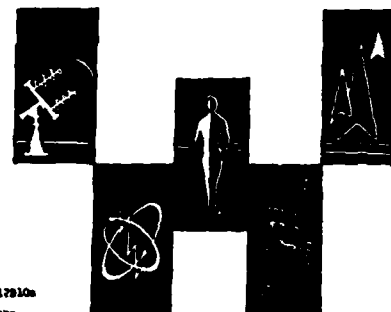
1944

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# ARMED SERVICES VOCATIONAL APTITUDE BATTERY

FORM 10a



DDO 1304.17810a  
OCTOBER 1979

CONTROLLED ITEM (For Marking)



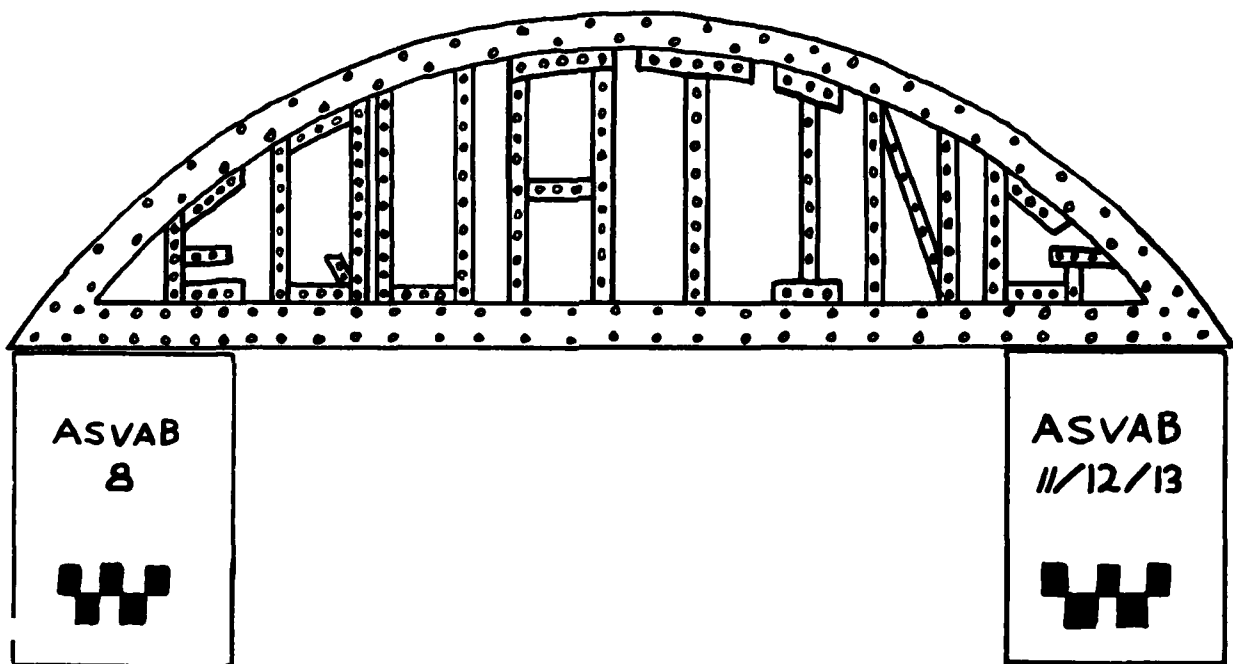
1980

TITLE: Equating Procedures for Military Operational Tests

PRODUCT: Procedures for Equating Aptitude Tests in Samples with Restricted Ranges

DESCRIPTION: Historically, military enlistment tests have been normed to previous tests through a technique known as equating. The equating procedure converts the scores of one test to the scores of another. The selection and classification test used by all the services, the Armed Services Vocational Aptitude Battery (ASVAB), is presently revised on a 3-year cycle. Due to revision, it is necessary to derive scores on the new test which are comparable to those on the old test. This permits the comparison of the ability of current recruits with that of past recruits. The present method for deriving scores on revised tests is accomplished by collecting scores on the two tests and equating (or calibrating) them using percentiles. The raw scores for both new and old forms are collected on a fairly large sample of service applicants who are given both tests. The chief psychometric concern with equating using recruit samples is that the recruits have already been preselected on aptitude measures and lower-ability applicants have been eliminated.

This concern prompted an AFHRL investigation into the effects of equating ability tests when samples have been restricted by preselection. The results provided a clearer understanding of the impact of sample size and restriction on calibration accuracy. Procedures were developed for use in equating test measures for operational testing programs. In April 1983, these procedures were utilized in equating ASVAB Forms 11, 12, and 13 to ASVAB Form 8.



THE BRIDGE BETWEEN TEST VERSIONS

TITLE: Air Traffic Controller Selection

PRODUCT: Test Battery for Air Traffic Controllers

DESCRIPTION: A test battery was designed to identify people most likely to complete Air Traffic Controller training successfully and achieve Federal Aviation Administration (FAA) certification 1 year after assignment to an operational facility. The battery is a combination of existing Air Force and FAA tests with some new tests designed specifically for predicting Air Traffic Controller tasks. Prior to development of the battery, entry into the Air Traffic Control specialty required either a General or Administrative aptitude score. As a result of AFHRL's R&D, the Administrative score requirement was deleted in the 31 October 1982 change to AFR 39-1, Airman Classification Regulation.

Additionally, AFHRL developed an Air Traffic Controller-unique ASVAB subtest composite score which further improves the prediction of success. Incorporation of specialty-unique composite scores in the Procurement Management Information System (PROMIS) was recommended by Headquarters USAF.



TITLE: Pilot Selection and Classification

PRODUCT: Psychomotor Test for Pilot Selection

DESCRIPTION: This multiyear R&D program was designed to improve the way the Air Force selects students for pilot training. One area of concentration in this program is the development of additional pilot aptitude tests for use in rank-ordering pilot training candidates.

A psychomotor, or hand-eye coordination, test was developed and given to 1,275 candidates prior to their entering flying training. It was found that the psychomotor test was a significant predictor of the graduation or elimination of these students from pilot training. Additionally, the psychomotor test was found to add unique predictive information to the operational pilot selection system. The next step was to determine the best way to integrate the psychomotor test into the operational selection system. Statistical analyses identified the most effective weighting of the psychomotor test information and identified improved ways to use existing information about pilot training candidates.

AFHRL has shown that a pilot selection system which incorporates psychomotor testing is more accurate than the current system and has the potential to lower pilot training attrition and to improve the performance of students by ensuring that the best available candidates are selected.





PSYCHOMOTOR  
TEST



PILOT  
SELECTION



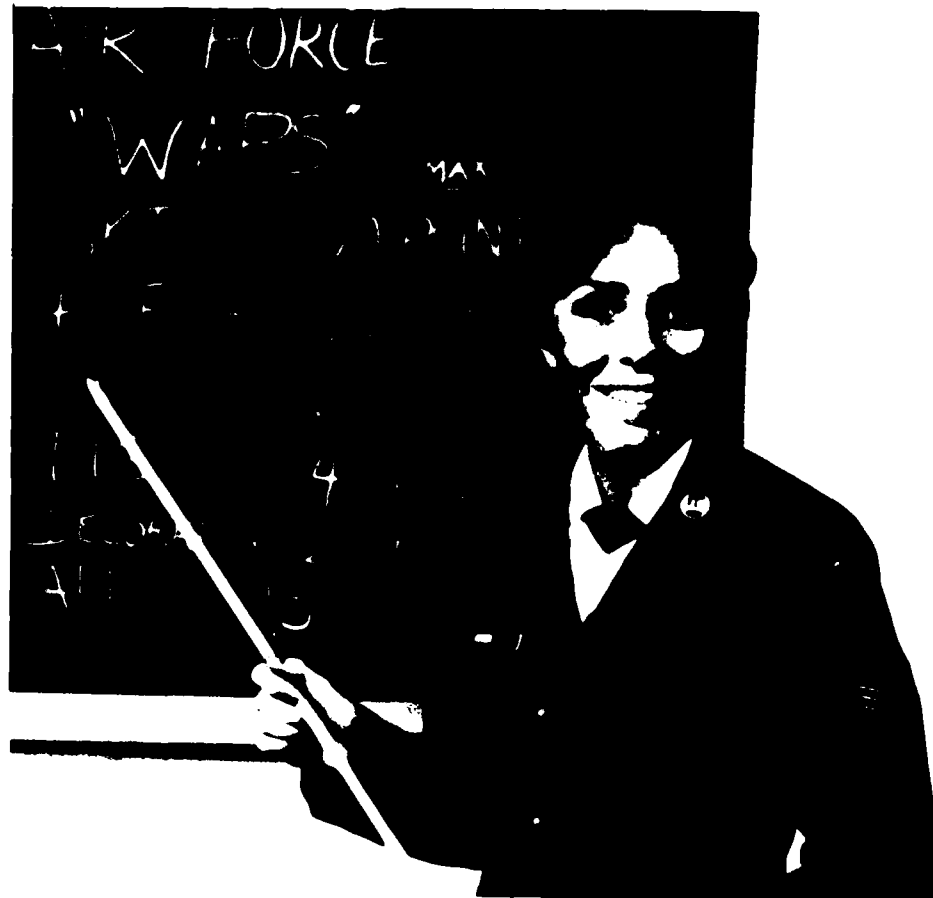
TITLE: Weighted Airman Promotion System (WAPS) Follow-On Development

PRODUCT: Alternative Weighting Systems for Enlisted Promotion Selection

DESCRIPTION: WAPS has been used by the Air Force since June 1970 for all enlisted promotions to Staff Sergeant through Master Sergeant. Follow-on R&D by AFHRL has included periodic reevaluation and applications to other areas; e.g., promotion to the senior enlisted grades, promotion in the Air Reserve Forces, and selection of cadets for the Reserve Officers Training Corps (ROTC).

In response to a request from the Directorate of Personnel Plans at Headquarters USAF, AFHRL developed alternative weighting systems for the Airman Performance Report (APR) factor in the operational WAPS formula. The objective was to minimize the problem of promoting individuals to SSgt through MSgt with recent low APRs (those APRs scoring 7 or less out of 9). This problem of WAPS selection of "poor performers" is a major concern of the Air Staff. AFHRL study of variations and combinations of weighting strategies resulted in the development and evaluation of over 30 alternative weighting systems. The most promising systems were selected and applied to actual airman records in three past WAPS cycles to assess each system's impact on promotion outcomes.

The information developed through this effort could be used to remedy the problem of promotion selection of poor performers as well as to bring the WAPS formula into better alignment with management's position regarding job performance. Equity in promotion selection and emphasis on recent performance are important factors in a promotion system that impacts upon the all-important mid-level grades of the enlisted force. Retention rates, job performance, and morale depend on a system that is equitable.



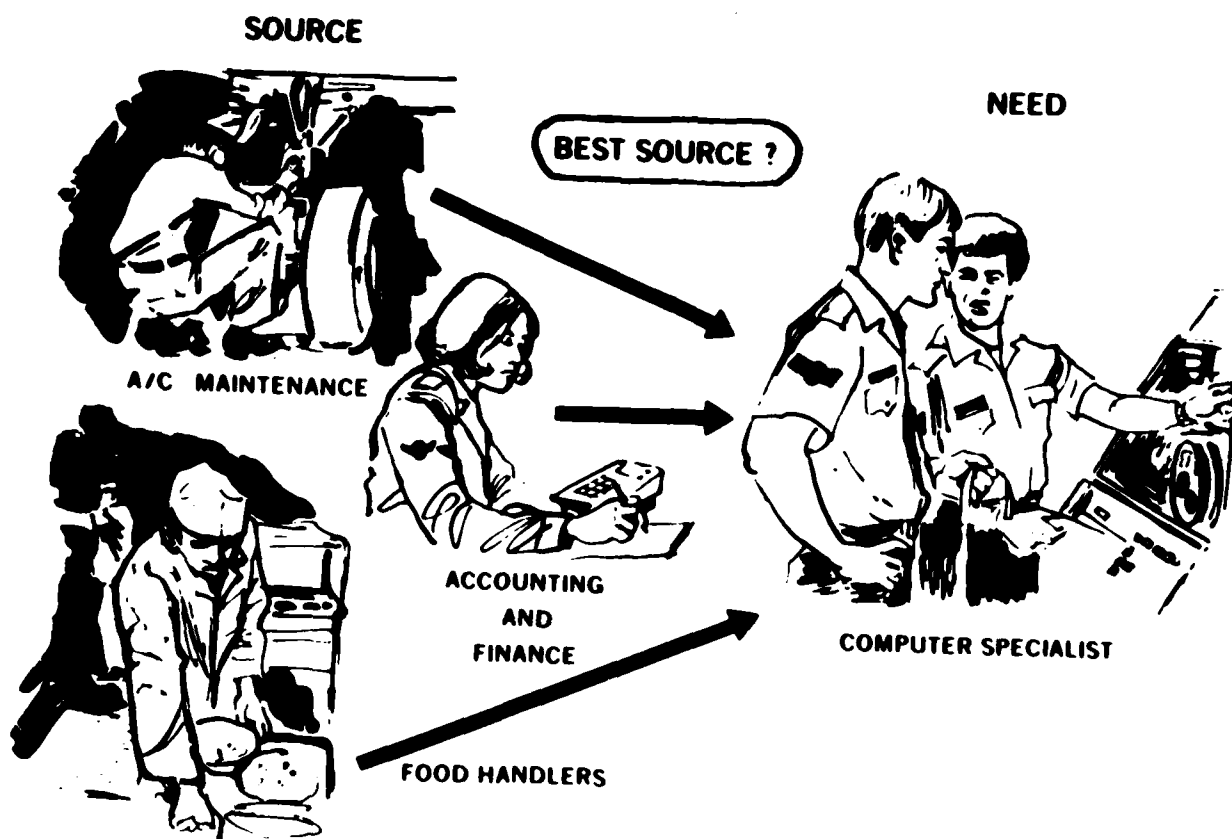
WAPS FACTOR WEIGHTING

TITLE: Occupational Retraining

PRODUCT: Analysis of the Retraining Program and Guidelines for Retrainee Management

DESCRIPTION: This R&D evaluated the impact of changing Air Force specialties (AFSs) on the performance, adjustment, and job and career progress of retrained enlisted personnel. The study systematically tracked the progress of enlisted personnel who had retrained into a second military specialty. It provided Air Force retraining managers with empirically based information and guidelines for improving the current retraining system. A major purpose of the R&D was to identify those factors which promoted successful retraining. The factors considered included both the characteristics of the individual being retrained and the circumstances of the reassignment action. Other information relevant to specific policy concerns or to program management in general was also considered. Overall, study results were favorable and indicated that retraining airmen to balance AFS manning requirements is a sound management practice.

Recommendations and guidelines to improve the management of nonvoluntary retraining actions and the selection and assignment of retrainees were provided to policymakers at the Air Force Directorate of Personnel Programs, and the Air Force Manpower and Personnel Center. Data from the study have been used in the formulation of a policy which established a 13-year time-in-service cutoff for retraining nonvolunteers. Results also provided evidence supporting the current practice of waiving 10 points of the job entry aptitude requirements into an AFS for retrainees.



TITLE: Historical Airman Database Applications

PRODUCT: Data on the Effects of the Selective Reenlistment Bonus on Retention

DESCRIPTION: Using data from AFHRL's Historical Airman Database, important information on the effects of the Selective Reenlistment Bonus (SRB) has been produced. The extensive 25-year database is composed of historical enlisted personnel data and national economic and policy variables. The SRB study involved an econometric analysis of retention in selected Air Force Specialties (AFSSs), particularly those having chronic shortages. Included in the analysis were the most influential institutional and market factors. Market factors were represented by variables such as civilian wages representing the Air Force's closest competitor for the specialized labor of a given AFS, unemployment rates, and GI Bill payments for formal training. The institutional factors included military compensation, reenlistment bonuses, quarterly force level, and others.

A table of retention improvement factors which shows the effects of applying an SRB has been provided to the Directorate of Personnel Programs at Headquarters USAF. This table, along with other results, provides evidence as to whether the SRB will affect career shortages of a skill. The information enables Air Force managers to project what the impact on retention will be when SRBs are applied to or taken from an AFS, and will be used by the Air Staff to justify elements of the SRB program in reports to the Office of the Secretary of Defense and the Congress.



SELECTIVE REENLISTMENT BONUS

## TRAINING SYSTEMS



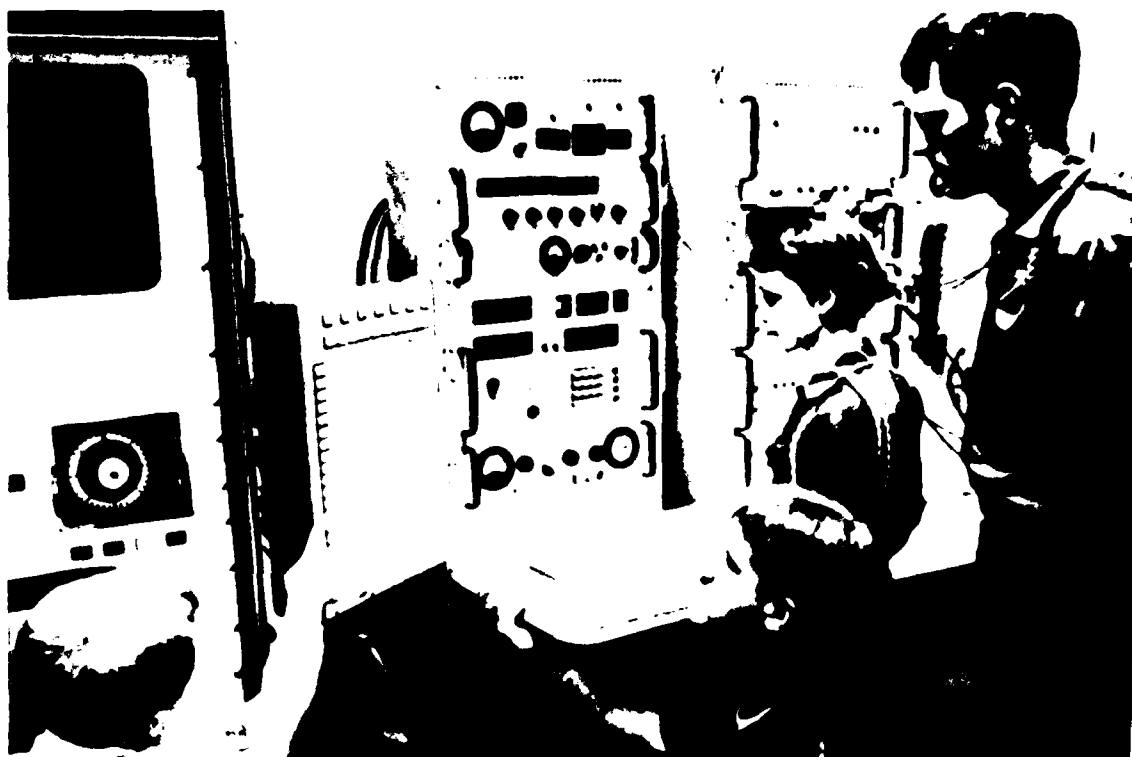
TITLE: Comparative Evaluation of High and Low Fidelity Maintenance Simulators With Actual Equipment

PRODUCT: Cost and Training Effectiveness Data of Maintenance Simulators as Compared to Actual Equipment

DESCRIPTION: This effort involved a comprehensive comparative cost and training effectiveness evaluation of (a) a Converter/Flight Control (6883) three-dimensional simulator, (b) a two-dimensional simulator, and (c) an actual test station.

Students were assigned to various training and testing modes utilizing the actual test station or one of the two simulators. Student knowledge of routine procedures, use of technical diagrams, and operation of equipment for troubleshooting malfunctions were assessed as a function of the training equipment used. User acceptance was evaluated based on student and instructor interviews and analysis of equipment use patterns.

Student performances were essentially equal following training either on simulators or on actual equipment. The simulators, however, were shown to be more consistent and more reliable in delivering a full range of training. According to the 15-year life-cycle cost comparisons, the simulators were decidedly less expensive to procure and operate: (a) actual equipment \$5.3M, (b) three-dimensional \$2.1M, and (c) two-dimensional \$1.6M. Although the maintenance simulators are not being used, the results showed that they were acceptable for training. A cost/training effectiveness study of an Interactive Graphics Simulator (IGS), which is a micro-computer/video disk-based device, versus actual equipment will be completed in FY84.



LOW-FIDELITY TWO-DIMENSIONAL SIMULATOR



HIGH-FIDELITY THREE-DIMENSIONAL SIMULATOR

TITLE: Improved USAF Non-Destructive Inspection Technician Capabilities

PRODUCT: Specifications, Including Costs, for an Ultrasonic Non-Destructive Inspection Trainer.

DESCRIPTION: Air Force non-destructive inspection technicians have not been finding flaws in aircraft structures with the precision and reliability demanded by aircraft design engineers. As a result, specifications were developed for a stand-alone trainer that would allow inspectors to practice the ultrasonic inspection technique on the job.

The specifications were derived in two phases. Phase I specified the functional requirements--the performance characteristics of the trainer and the behaviors which the trainer was to develop and sustain. Phase II specified the engineering/physical characteristics the trainer must have in order to accommodate those functional requirements from Phase I.

The specifications have potentially wide applicability throughout the military and civilian nondestructive testing communities. Both the Air Training Command and the Air Force Logistics Command have plans for early applications.



NONDESTRUCTIVE INSPECTION  
OF A CASTING

TITLE: Personnel Requirements for Nonconventional Instruction

PRODUCT: Nonconventional Instruction Role Model

DESCRIPTION: This effort investigated the roles and behaviors of instructors in nonconventional instruction (NCI). The theoretical role model against which data in this study were analyzed establishes the ideal role order as counselor, modeler, evaluator, diagnostician, remediator, implementor, and planner.

Considerable variability was found in the order of, and in time spent in, the behaviors required of instructors across NCI courses. Principal findings from analysis of the data were (a) NCI instructors spend more time than is optimum in administrative, clerical, and instructional management roles, and less than optimum time in learning facilitator and tutorial roles; (b) percentages of time spent in theoretically ideal roles are influenced by the instructor's years of experience and attitude about both the job and prior job training; and (c) number/types of instructor-perceived problems are influenced by those same factors. Approximately 20% of instructor time is spent in roles not included in the theoretical role model, such as author, equipment maintainer, supervisor, and miscellaneous clerical and administrative duties. These were suggested as candidate roles for non-instructor personnel, leaving as the primary thrust of instructor training the preparation of instructors in the ideal roles/behaviors. By emphasizing the use of instructors in the designated ideal roles and behaviors and assigning remaining functions to non-instructor personnel, training for instructors can be more specific in preparing them to function effectively on the job.



SMALL-GROUP  
INSTRUCTION

OPERATIONS  
TRAINING

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**TITLE:** Assessment of Workload and Prediction of Performance by Combined Psychophysiological and Behavioral Techniques

**PRODUCTS:** (1) A System Designed to Provide Simultaneous Recording of Several Psychophysiological Functions in the Advanced Simulator for Pilot Training.  
(2) Results for Prediction of Level of Simulator Performance, Especially by Cortical Evoked Response Potential (ERP)

**DESCRIPTION:** The utility of multiple physiological indices of pilot attention and workload for flight simulator application was investigated. Such measures may be used with other behavioral metrics of pilot attention and task difficulty to optimally structure flight simulation training programs. Objectives were first, to establish laboratory facilities and procedures for processing the large quantities of data involved in psychophysiological research and second, to investigate the relationships among these variables and performance on information processing tasks.

A simplified laboratory flight simulation was the behavioral task. Heart rate, skin conductance, and respiration rate were studied as indices of autonomic arousal. Cortical ERPs, related to the complexity of the stimulus environment and associated processing requirements, were simultaneously recorded. The autonomic measures reflected the effectiveness with which the simulator scenario elicited an arousal response in the pilot. Both the early and late components of the cortical evoked response potential varied with task difficulty and performance. These results suggest that psychophysiological measures may be usefully employed to structure simulator training sequences to elicit optimum levels of stress and workload. This effort was co-monitored with the USAF School of Aerospace Medicine.





IN-SIMULATOR  
PSYCHOPHYSIOLOGICAL  
MEASUREMENT

**TITLE:** Low-Altitude Database Development Evaluation and Research (LADDER)

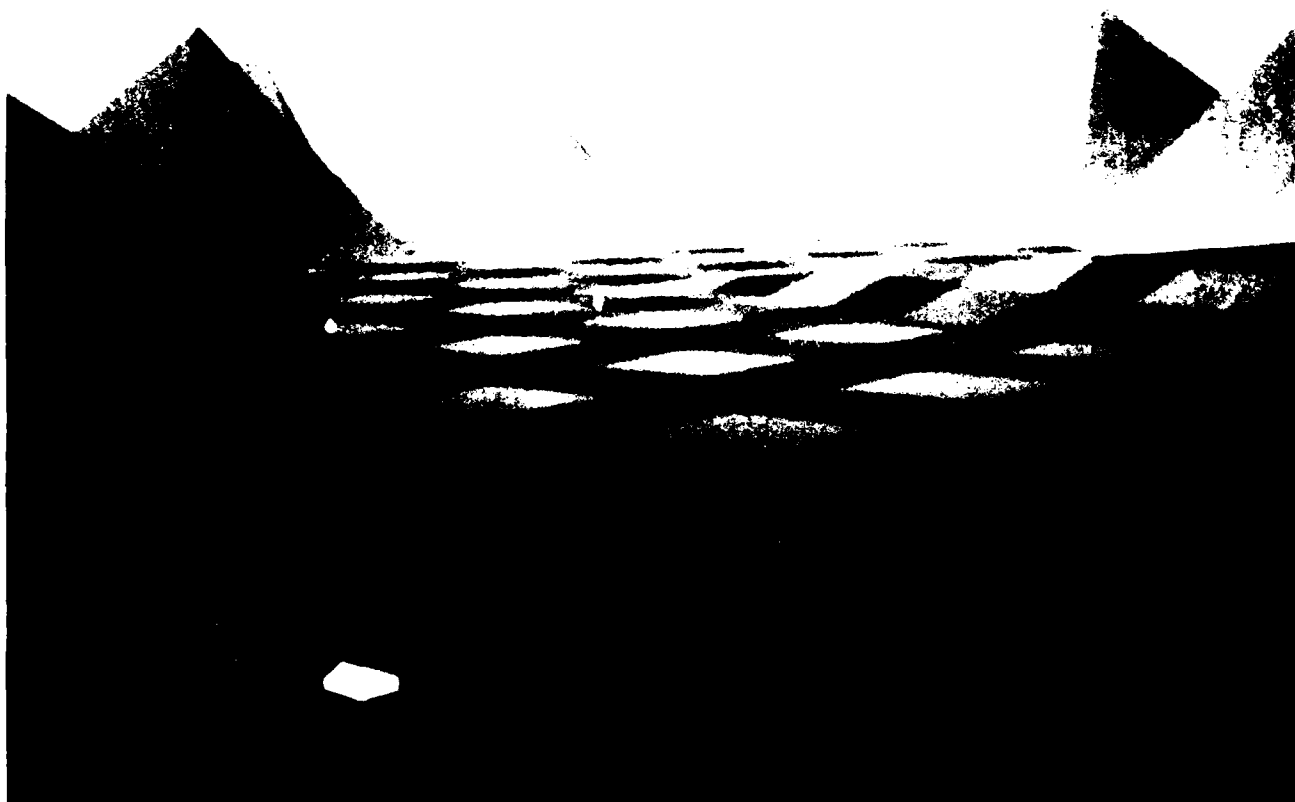
**PRODUCT:** Study Results of Low-Altitude Databases.

**DESCRIPTION:** This effort investigated the effects of alternative visual cue displays on pilot performance in a simulated low-level flight task. Two flight tasks were factorially combined with four surface texture and five vertical object conditions to provide 40 test cue conditions provided to the pilot in the form of a continuous flight course.

The conditions were as follows: (a) task: steep and shallow turn; (b) surface texture: none, 150' sq, 300' sq, or 450' sq pattern; and (c) vertical objects: none, houses, storage buildings, trees, and a combination of types spaced 1500 feet apart. In addition to the 40 test conditions, there were 16 replicates combined to provide a 420-mile course containing 56 sections. The course was 3000 feet wide and contained ridges and hills, with mountains bordering the sides. The pilot's task was to fly through the course at 480 knots at 100' above ground level without the aid of altitude instruments. The visual display was provided by the F-111B color digital image generation visual system and three associated wide-angle windows. The flight simulation was provided by ASPT/F-16 flight dynamics in a T-38 cockpit with a static, pressure-sensitive, centerline stick. Eighteen experienced fighter pilots served as subjects.

The results indicated that both surface texture and vertical objects influenced flight control. The effect of surface texture was not a simple monotonic function of pattern size, but interacted with object type. The mixture object condition was superior to the other conditions. The absence of texture and objects resulted in a higher rate of terrain collisions and a higher level of reported pilot discomfort than did any of the other conditions.

The results of this study were used to make recommendations to the Tactical and Strategic Air Commands regarding the use of their operational visual systems for low-altitude database development and training. In addition, the results of this study, combined with information from previous and other ongoing efforts in visual displays for low-altitude flight, will be used to formulate design specifications for future systems.



LADDER VISUAL SCENE

TITLE: Field Of View (FOV) for Selected F-16 Weapons Delivery Tasks

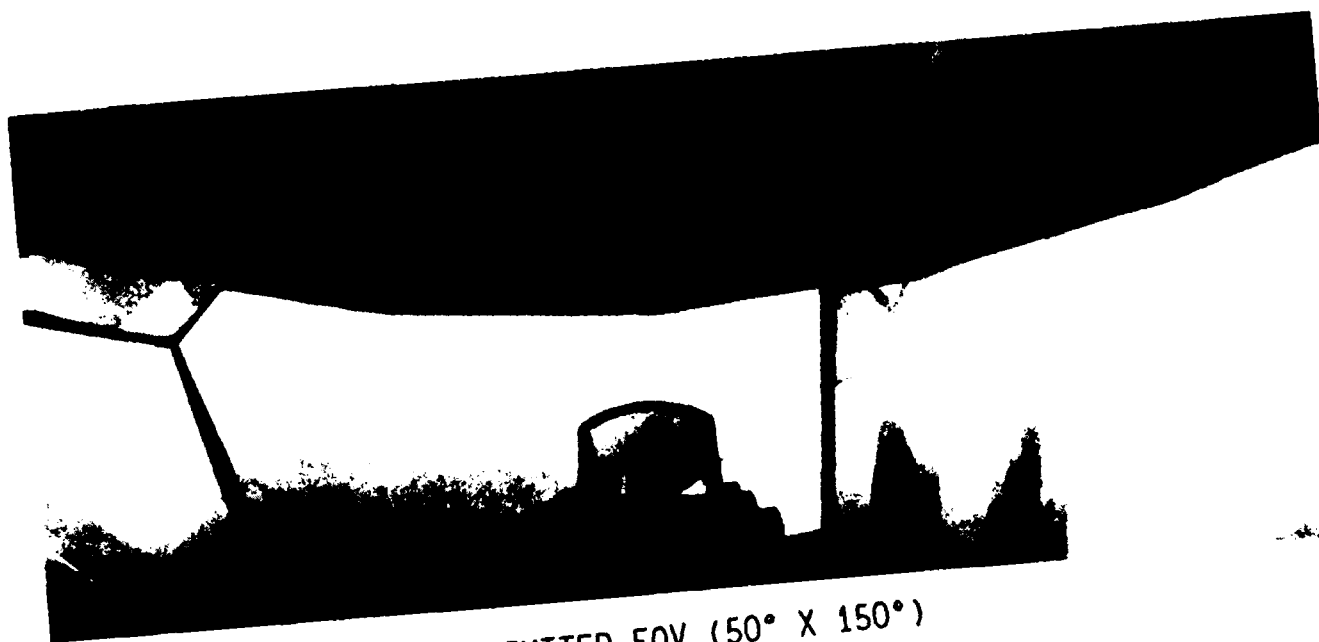
PRODUCT: Data on the Dimensions of Maximum FOV Required to Keep Target Visible for Air-to-Air and Air-to-Ground Weapons Delivery Tasks.

DESCRIPTION: Mission-qualified F-16 pilots performed seven air-to-air weapons delivery tasks in the Simulator for Air-to-Air Combat, and seven air-to-ground weapons delivery tasks in the Advanced Simulator for Pilot Training. The position of the target in the visual display was continuously plotted to obtain the maximum FOV actually used during each task. Each subject flew four trials of the air-to-ground tasks and five trials of the air-to-air tasks in a full (150°x150°) FOV. To measure the effect of a proposed limited-FOV system, subjects also flew four trials of each air-to-ground task using a 150°x50° FOV.

Results indicated that for the tasks used in this study, a full FOV is not used. However, while reducing the FOV did not significantly affect bombing performance, pilots tended to alter their flight path by turning onto final earlier.



FULL FOV (150° X 150°)



LIMITED FOV (50° X 150°)

**TITLE:** Comparison of Some Flight Simulator Visual Displays

**PRODUCT:** Data That Showed Stereopsis and Wide Field-of-View (FOV) Helped Pilots in Simulated Aerial Refueling.

**DESCRIPTION:** The displays were all used in the A-10 cockpit of the Advanced Simulator for Pilot Training (ASPT). The configurations were (a) a helmet-mounted stereoscopic display with a 40° FOV; (b) the full ASPT 300° FOV; (c) the ASPT visual display masked to 40° FOV; and (d) lead lanthanum zirconate titanate (PLZT) goggles (stereoscopic) using one ASPT window. This R&D was carried out to evaluate the relative merits of various display systems. For instance, is stereopsis associated with performance superior to other displays? Do optics directly in front of the eyes interfere with performance? Is wide FOV important? Is PLZT technology superior to helmet-mounted stereoscopic displays? Forty subjects participated in this research--eight per display condition.

Results obtained indicate that (a) stereopsis does aid aircraft control in aerial refueling at near distances (attached to the boom); (b) the presence of optics close to the eyes does not interfere with performance; (c) wide FOV aids performance in aerial refueling; and (d) performance with PLZT goggles was not as good as performance with the helmet-mounted stereoscopic display.



PLZT GOGGLES IN USE

**TITLE:** Fiber-Optic Helmet-Mounted Display (FOHMD)

**PRODUCT:** Breadboard Operating Phase I System

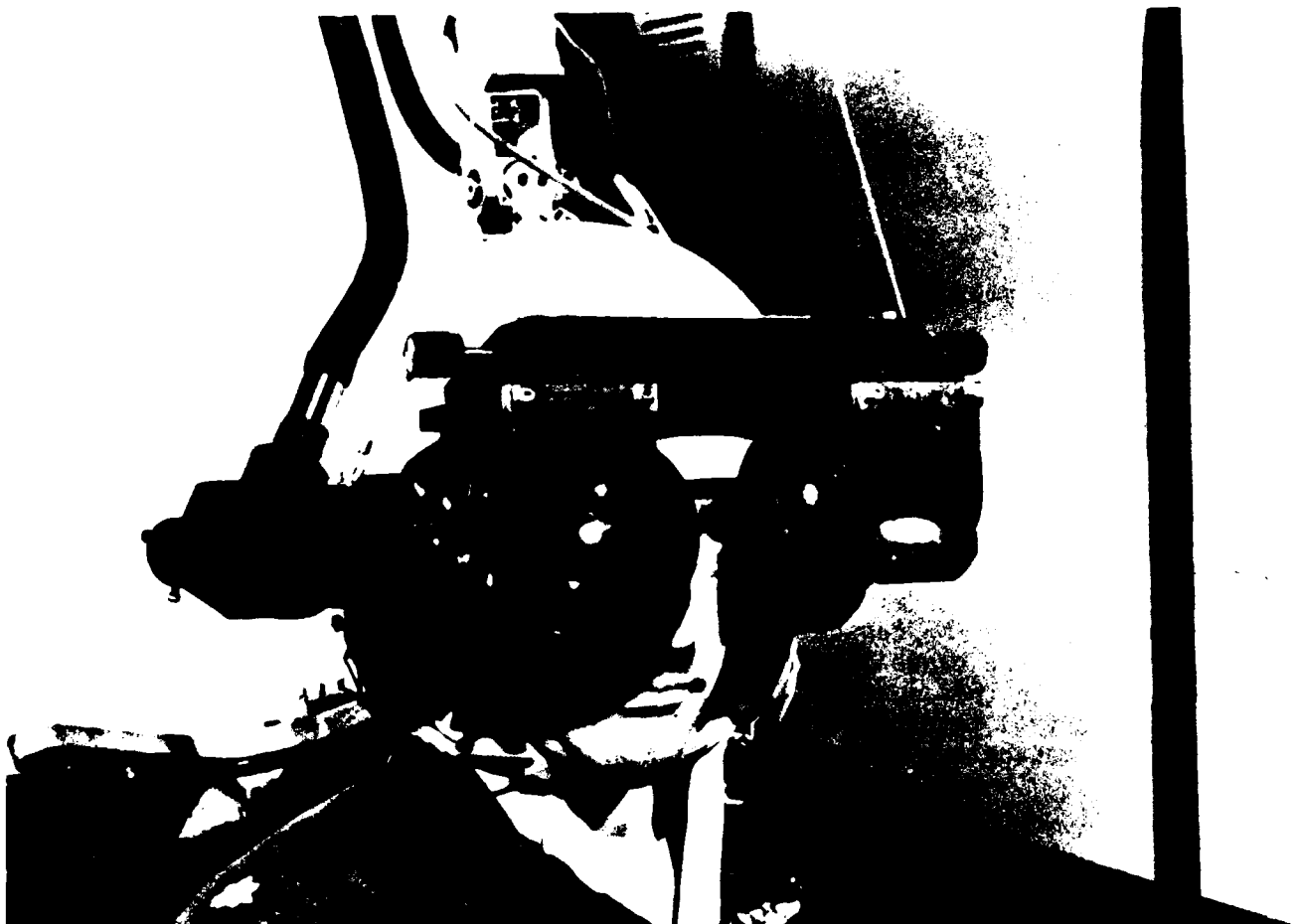
**DESCRIPTION:** The FOHMD is a Department of Defense-sponsored system to provide a color, high brightness, high-resolution, and wide field-of-view visual display required for tactical training.

This system uses coherent fiber-optic bundles to pipe imagery from high-brightness color projectors to a helmet display. The initial system uses two 15x15mm bundles and two 8x10mm bundles. It has a large, head-slaved background area with a central high-resolution inset which can be configured to encompass either 260 or 400. An optical steering system is used to compensate for computerized image generation transport delays of up to 100 msec. Phase I performance parameters are brightness of 80 foot-lamberts (color); resolution of 1.5 arc minutes for foveal field; 5.5 arc minutes resolution for peripheral field; and unrestricted field-of-view (135°x60°, instantaneous).

Behavioral research with the Phase I breadboard system has been conducted to establish binocular overlays and other parameters for a Phase II prototype.

The Phase II refinement effort allows a reduction from four to two bundles, as well as a reduction in bundle size. Dynamic multiplexing will be used to decrease the honeycomb effect of the fiber structure. An optical head-tracking system provides high dynamic accuracy. This system can fully display the capabilities of state-of-the-art image generators and can also be used in conjunction with the Advanced Visual Technology System.





PERIPHERAL FIELD CHECKOUT  
ON BREADBOARD FOHMD

TITLE: C-5A Simulator Performance Measurement System (PMS)

PRODUCT: The Simulator Portion of the PMS System and Its Operational Test and Evaluation Data.

DESCRIPTION: The long-range objective is to determine the relationship of aircrew performance in simulators to subsequent performance in the actual aircraft. The immediate goal is to develop a computer-based system that will generate objective indices of performance in the simulator.

A prototype system has been developed using the C-5A flight simulator as a test vehicle. The system acquires data directly from the flight simulator through specially designed interfaces. It uses its own computational capacity to generate the objective measures of aircrew performance.

The simulator measurement system has been completed and successfully integrated with one of the C-5A flight simulators at Altus AFB. During FY83, test and evaluation of the simulator measurement system was initiated, and it is being used in support of copilot training at Altus AFB. The system will provide the Military Airlift Command with quantitative assessment of C-5A aircrew training effectiveness and will aid in the development of functional specifications for future simulators. In operational terms, the C-5A PMS will enable the objective measurement of many relatively tedious tasks such as checklists, procedures, navigational profiles, and maintaining prescribed flight parameters. This will enable the instructor/examiner to concentrate efforts on higher-order skills such as crew coordination and resource management. The PMS can be used extensively in simulator training programs, since it has the capability to automatically generate predefined mission scenarios. In this context, the C-5A PMS can provide an important quality-control function in that it will become the basis for the more efficient management analysis of training programs.



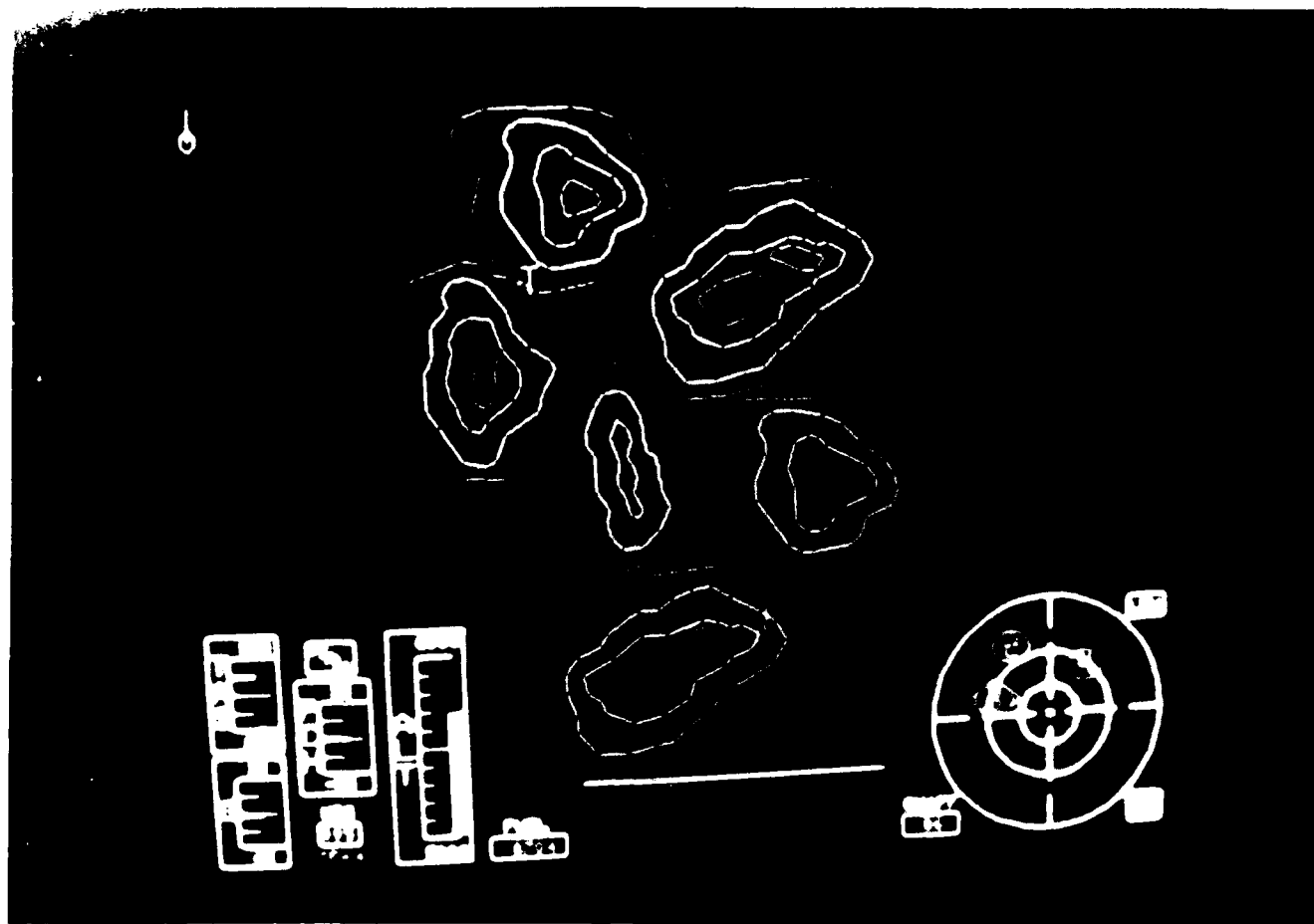
SIMULATOR PMS

**TITLE:** Generic Threat Recognition Trainer

**PRODUCT:** Highly Flexible Desk-Top Part-Task Trainer with User-Friendly Characteristics

**DESCRIPTION:** The generic Threat Recognition Trainer provides the basic gaming elements of air-to-surface electronic combat in a compact desk-top system. The student pilot learns to identify and evade various enemy defenses while attempting to destroy ground targets. Variable terrain features, aircraft flight parameters, radar warning receiver, and electronic countermeasures effects are provided.

The trainer is comprised of off-the-shelf commercial devices integrated with a computer. The combination of industry-standard hardware and software allows easy use of add-on equipment and widely available high-level language processors. The major additions to the basic computer are a very flexible color graphics system and a joystick/throttle arrangement for analog inputs by the trainee. This arrangement allows the pilot to interact with the computer program on a real-time basis. Additional equipment includes a sound board which simulates the audio signals associated with the radar warning receiver. User-friendly menus have been designed to allow the trainee the following options: (a) view an intelligence briefing prior to a pass, (b) view the probability-of-kill graph of the last pass, (c) perform another pass, or (d) create a new environment. The trainer also has freeze and abort capabilities. As requirements change, the system can be modified to accept new software and hardware and thus should provide relevant training in threat recognition and avoidance at the operational squadron level for many years.



ACTUAL TRAINER DISPLAY

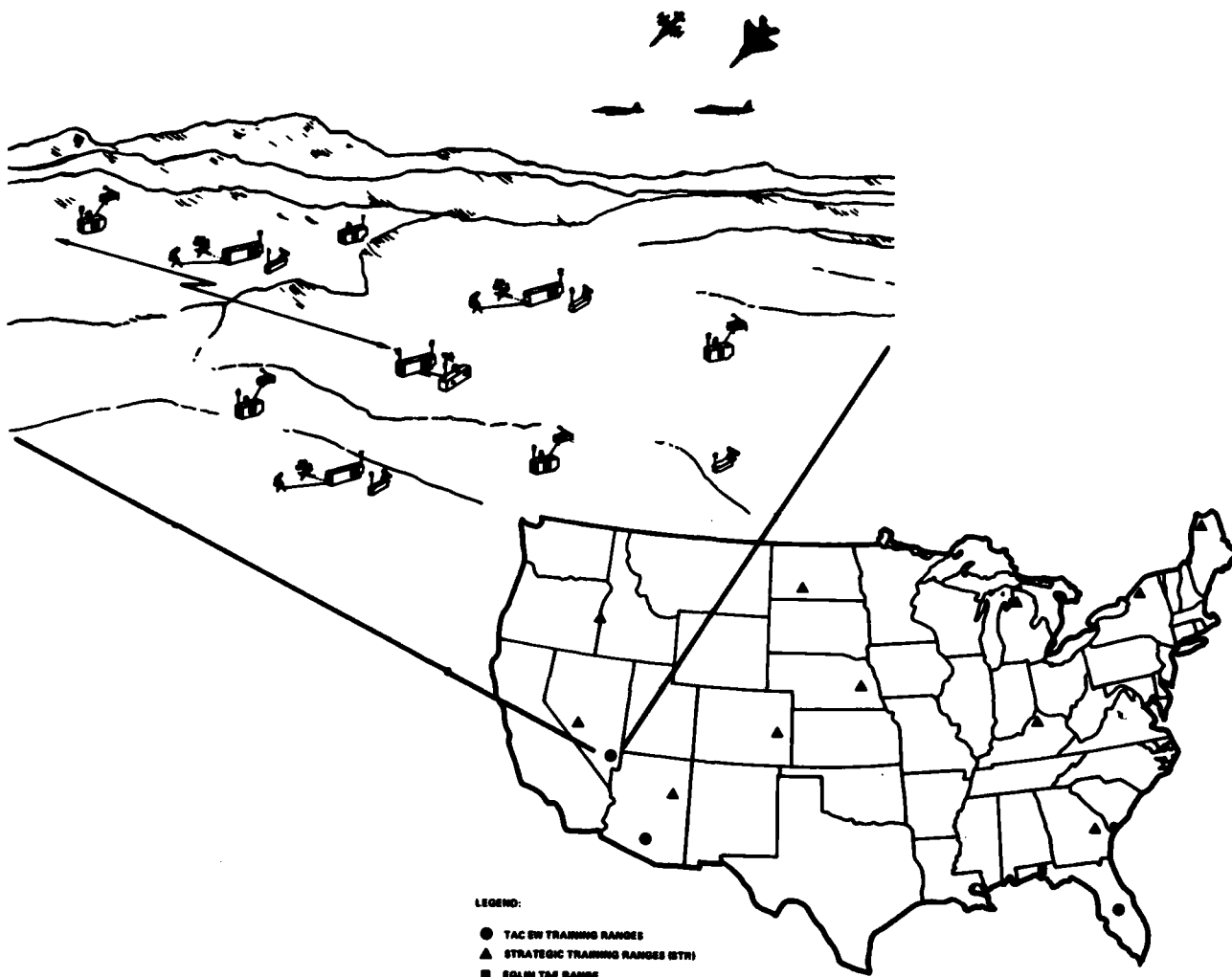
**TITLE:** Radar Warning Receiver/Electronic Countermeasures Part-Task Trainer  
(RWR/ECM PTT)

**PRODUCT:** RWR/ECM PTT

**DESCRIPTION:** In response to a training deficiency in electronic combat (EC) skills, an RWR/ECM PTT was developed. The objective was to evaluate existing microcomputer technology for part-task training in EC as conducted in schools and operational units. There are two specific parts to this objective: (a) to develop a PTT for large-scale cost avoidance and (b) to provide demonstrations of part-task trainer designs for EC training and empirical validation of training effectiveness.

A color graphic representation of the RWR scope and indicator control panel is presented on a Microangelo Color Graphic system. The algorithms for simulating the RWR/ECM system have been developed. The appropriate audio signals accompanying the graphic display of the RWR are presented. Students interact with the graphic display through the use of a touch-sensitive panel. Interactive tests are available as selectable menu options and are designed so students can review as much or as little material as desired. Over 20 different malfunctions of each RWR system can be reviewed. The product includes RWR and ECM systems for six Tactical Air Command (TAC) aircraft. The software generating the simulation is compatible with computers purchased for use at operational squadrons, keeping cost extremely low.

Reduced training time/costs will be realized through enhanced efficiency of EC training. The results will provide a low-cost, training-effective PTT that will enhance aircrew survivability.



## ELECTRONIC WARFARE RANGES

LOGISTICS AND HUMAN FACTORS

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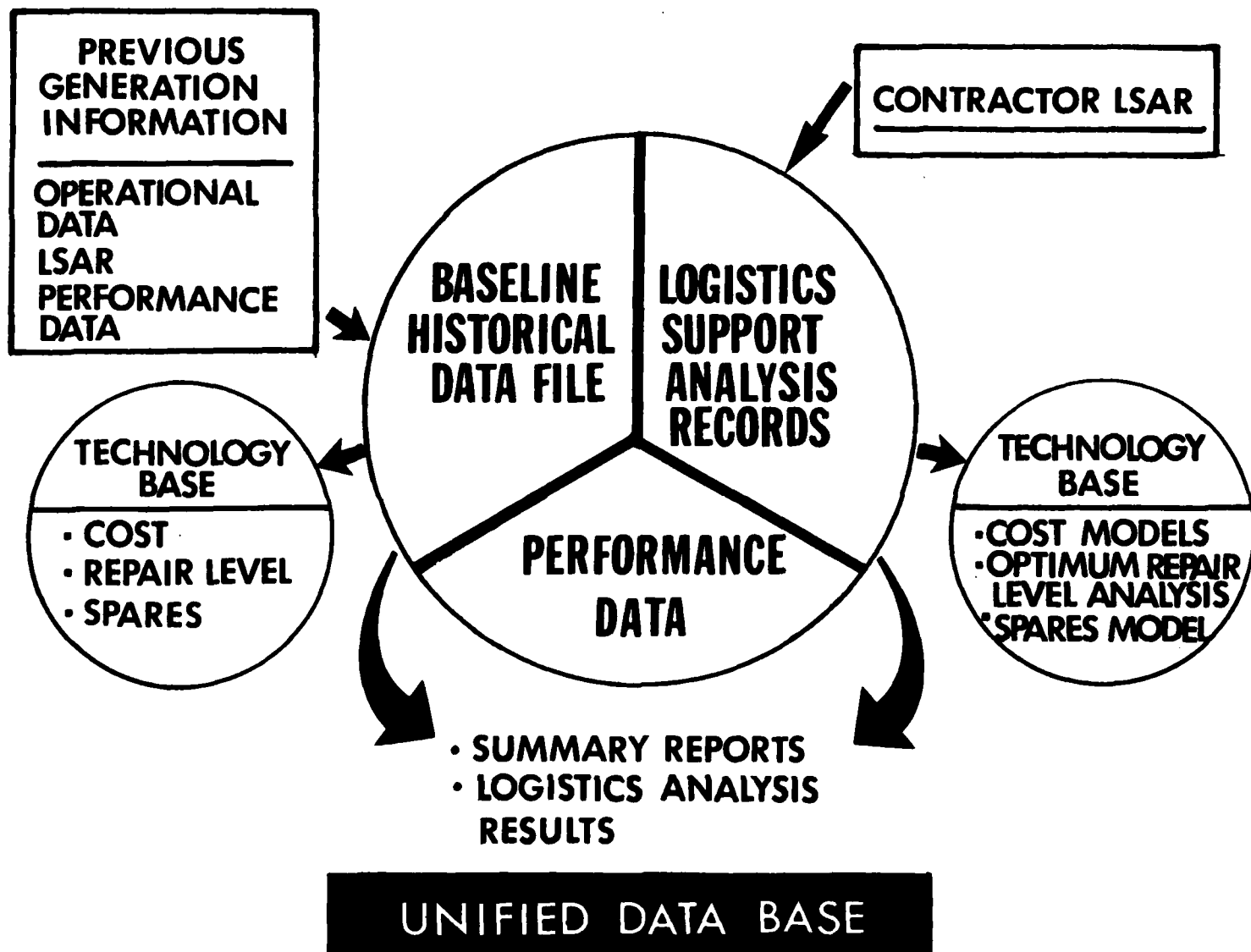


**TITLE:** Unified Database Technology

**PRODUCT:** Prototype Unified Logistics Database Software

**DESCRIPTION:** The unified logistics data base provides a central automated source of logistics information to support weapon system acquisition. This information addresses reliability, maintainability, ground support equipment, built-in test equipment, task analysis, skill level, maintenance team size and specialty classifications, training requirements, technical data, and spares. The technology provides information needed to allow logistics to impact weapon system design. The unified database is programmed for easy access and a variety of data output modes is available to the user. Prototype software has been developed and tested, and it is currently being used in the development of the HH-60 helicopter and the defensive avionics systems for the B-1B aircraft.

The technology developed in this effort forms the basis for addressing Air Force Operational Test and Evaluation Center needs, computer-aided design interfaces, and the interface with Air Force Logistics Command data systems to feed back experience from the field.



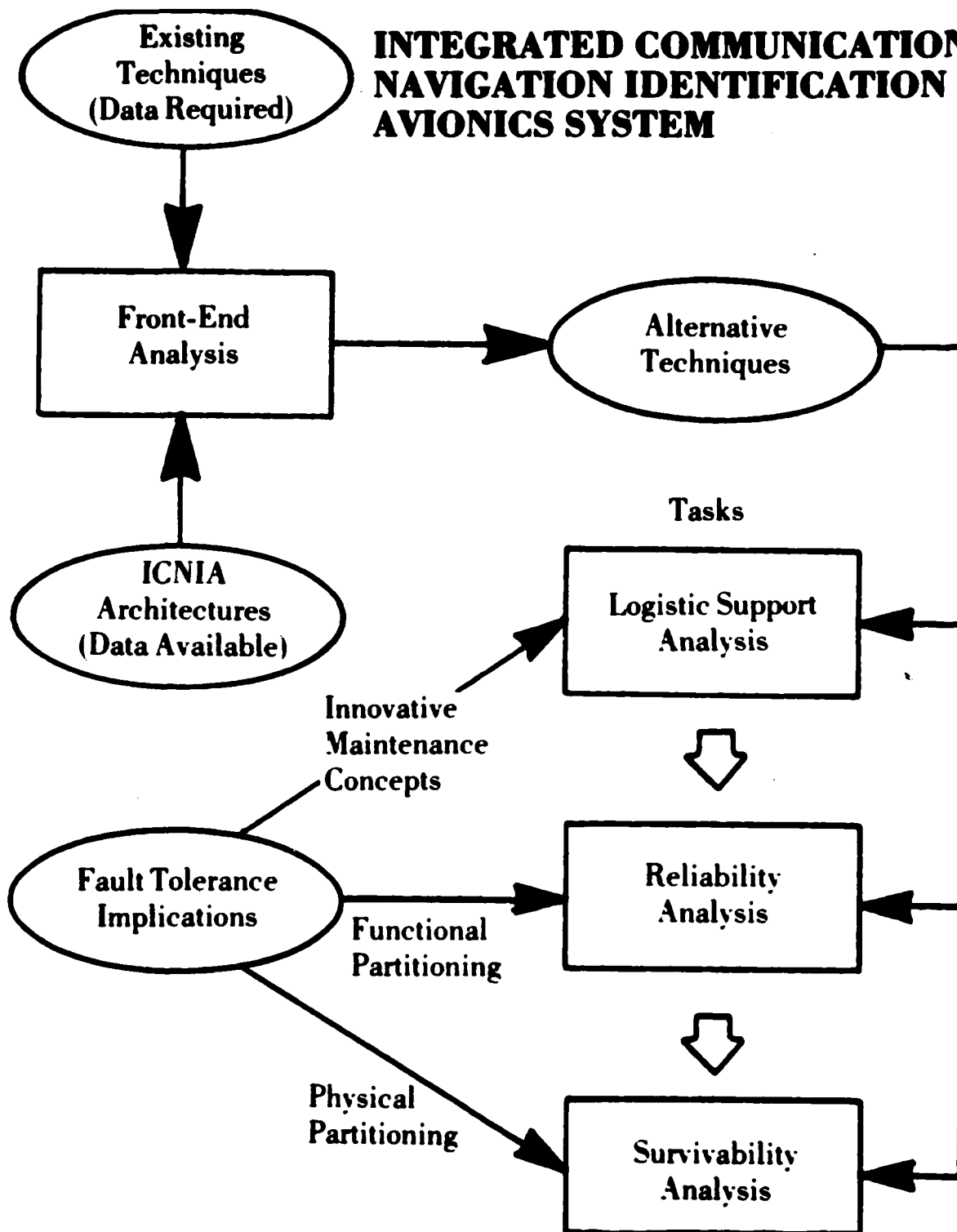
**TITLE:** Analysis of the Integrated Communications Navigation Identification Avionics System

**PRODUCT:** Reliability Model of Self-Regenerating Systems

**DESCRIPTION:** Front-end analysis techniques were developed that incorporate logistics engineering parameters into system design during the conceptual phase. These analysis techniques consider logistics support, reliability, and survivability of new avionics. Among the unique problems addressed was the development of reliability analysis for self-reconfiguration and graceful degradation. These analysis techniques were demonstrated by applying them to two conceptual Integrated Communications Navigation Identification Avionics (ICNIA) system architectures developed by the Air Force Avionics Laboratory.

Previously, there had been no existing analysis techniques for assuring reliability of self-reconfiguring systems. The reliability model makes it possible to evaluate the impact various conceptual designs have on equipment reliability, maintainability, and survivability. These analysis techniques are being used by engineers to evaluate the impact of various conceptual design elements and optimize the final design of equipment.

# INTEGRATED COMMUNICATIONS NAVIGATION IDENTIFICATION AVIONICS SYSTEM



TITLE: Maintenance Demand Metrics for Peacetime Operations

PRODUCT: Regression Equations That Predict Maintenance Demand Rates for Aircraft

DESCRIPTION: Regression equations were developed which are specific for each type of aircraft (tactical, bomber, and trainer) and for each type of subsystem (e.g., bombing-navigation, landing gear, engines). These equations provide maintenance demand rates for aircraft subsystems as a function of environment, design characteristics, and operations requirements. They are more precise and accurate predictors than those based on the traditional "flying hour" or "sortie rate" metrics.

The data developed provide the necessary computational equations and supporting information to enable the users to apply them to aircraft maintenance demand problems. These methods provide increased sensitivity in prediction for manpower determination studies, cost-of-ownership studies, new basing and deployment planning, and design trade studies for aircraft systems under development. The next phase of this project will consider factors affecting maintenance demand rates during wartime operations. Most of the metrics developed are available for use by the aerospace industry and are being used by Air Force analysts in planning support for new systems.



EXTREME MAINTENANCE ENVIRONMENTS



TITLE: Analysis to Improve the Maintenance Environment

PRODUCT: Factors Affecting Maintenance Personnel

DESCRIPTION: This effort identified factors that affect the performance of individuals, groups, and organizations performing aircraft and missile maintenance. These factors covered several areas such as retention, supervisory style, assignment, availability of manpower, organizational structure, training, job involvement, job/career satisfaction and status, work pressure, and competence.

Over 2,000 open-ended, one-on-one interviews were conducted with maintenance personnel representing active-duty aircraft, and missiles, and the Air Reserve Forces. The scope of the interviews ranged from senior management personnel down through the working-level technician. All major commands, including overseas forces, were represented, and interviewees were selected to represent different specialties, weapon systems, locations, skill levels, and maintenance environments. An integrated approach was taken, with special attention to the role of the human element in effective maintenance. A categorization/coding scheme was developed, based on the content of the interview data collected. Data were coded and stored in a computer database, and a software program was developed which allows flexibility in manipulating and analyzing the data. The resulting data bank provides maintenance organizations opportunities to identify factors that influence maintenance performance and possible steps for improving performance by applying existing technology. The data also provide a basis for identifying problems that require R&D to arrive at and test a solution.

The results of this effort have been extensively briefed and received with great interest by the participating Commands, Air Staff and maintenance commanders throughout the Air Force.



MAINTENANCE SUPERVISOR BEING INTERVIEWED

# TWO AREAS OF CONCERN

ON-THE-JOB TRAINING



JOB INVOLVEMENT





TECHNICAL SERVICES

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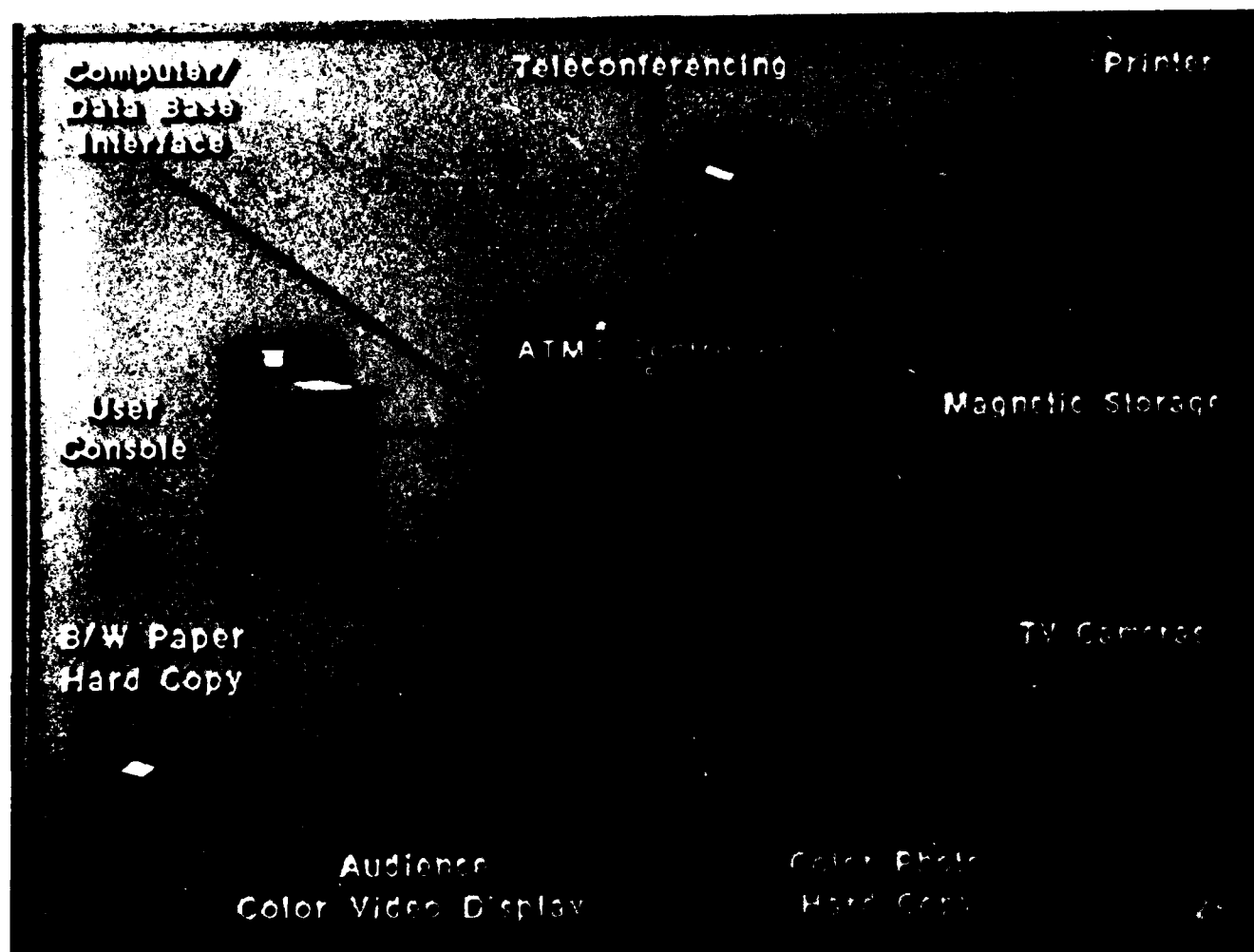
TITLE: Advanced Technology Multimedia Communications (ATMC) System

PRODUCT: Real-Time Teleconferencing Using Voice-Switched Network

DESCRIPTION: The ATMC system provides audio teleconferencing with color graphics, freeze-frame video, cursor pointing, and electronic handwriting. Significant ATMC accomplishments include:

1. Electronic handwriting in local and remote modes. When a briefer writes on a pad, it simultaneously appears on a screen miles away.
2. Low-resolution freeze-frame television cameras which allow pictures to be sent over the phone line.
3. Software modules that provide an artistry input capability for subsequent use during a briefing.

These capabilities have been installed and tested at AFHRL headquarters and will soon be used at four geographically separated locations. All ATMC-equipped sites have new synchronous protocol (DECNET) installed for use in transmitting error-free graphics from one location to another over standard telephone lines.



TYPICAL ATMC DISPLAY

END